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SCIENTIFIC FARMING

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The agriculture of the United States has passed through two definite stages of development and is now entering upon the third. It is profitable for the present purpose to review briefly this evolution.

As primitive agriculture exists it is known to the economist as the self-sufficing system; namely, each family undertakes to provide, year by year, sufficient food to last itself and its animals until the succeeding harvest. This system was inevitable in a new country, where practically everybody lived upon the land and was to all intents and purposes a farmer, and it is the system which prevailed until well into the lifetime of men still living.

With the increase of population and the development of manufacturing industries and transportation facilities, a large portion of the population began to devote itself to interests other than farming. This condition was necessary to the establishment of a market for agricultural produce and for the development of the second stage of agricultural evolution; namely, the money-making era. With the publication of each successive Census report we hear much about the decreasing percentage of those engaged in farming, as if it were a national calamity; whereas the truth is that if 100 per cent of our population had always remained in the country, there would be no market for the produce of the land, a money income from farming would be impossible, and agriculture would forever remain a family industry without returns beyond the bare necessities of living. In brief, it could never have risen from the self-sufficing stage to the money-making stage.

This money-making stage may be said, roughly speaking, to have begun with the Civil War, when the states from Michigan and Indiana east became wealthy in the production of wheat. This period was immediately followed by the development of the boundless prairies of the West, throwing upon the markets of the world

almost unlimited amounts of the cheapest beef and breadstuff that mankind has ever known. To be sure, it was all the time at the expense of virgin fertility, and the country has reaped the consequences, but the financial results were so enormous that the wealth of the states of the Mississippi Valley and the West may be said to have been drawn directly from the land; indeed, most of the bankers and merchants of the prairie states were first farmers.

The methods of procedure in this second stage of development were not very different from those of the first; namely, plowing, sowing and harvesting, which constituted the whole business of the farming so far as the land was concerned, and stock raising was little more than herding on the open range. The farmer of that generation was exploiting nature at a rate never before attempted. The havoc was terrific, but the wealth of the world was laid at the feet of men who acquired ownership of government lands either by homesteading or by the payment of a nominal fee of about a dollar and a quarter an acre. Men are yet living who acquired land in this way which is now worth two hundred and fifty and three hundred dollars per acre, enjoying not only this tremendous increase in land value, but large fortunes of personal property acquired from the soil during the interim.

In the meantime science was developing and laying the foundation for the third or scientific stage of farming, which we are just now entering with promise. As agriculture assumes this third and scientific stage in its evolution, the object is not so much the magnitude of production as it is the quality of the product and the economy of its production. The world could not long have lived under the oldtime destructive methods of agriculture, no matter how profitable they might have been temporarily to those engaged therein. The waste of fertility was too great. Lands that had been thousands of years in the making were ruined within a generation. Had those methods been continued, however temporarily profitable they may have been, the decline of the country would have been inevitable from sheer inability to wring sufficient sustenance from the soil.

Chemistry was the first of the sciences to turn its attention to agriculture, and the first two subjects studied were the scientific feeding of animals and the food requirements of crops. By the new methods of investigation devised by the scientist, it was speedily

discovered that the old feeding practices, while securing results, were yet enormously wasteful in that the rations were sadly unbalanced so far as the requirements of the animals were concerned, resulting in corresponding losses in food value. The result was the devising of a "balanced ration," which very nearly corresponds in its component parts to the real needs of an animal for nourishment and thus avoids the wastage of the surplus, particularly of the more expensive nitrogenous foods.

Turning his attention to the soil, the chemist found correspondingly wasteful practices. To be sure the farmer had learned through experience generations ago that manures and other fertilizers would increase the growth of crops, though he was about as particular to apply soot and other carbonaceous material as he was to apply the really effective fertilizers. The chemist quickly discovered that of all the elements necessary to the growth of plants only three need ordinarily to concern the farmer. Of these, nitrogen is enormously expensive, costing in the markets of the world some fifteen cents a pound, and as at least four pounds are required for a bushel of wheat it was evident that the wheat supply of the world must have been produced at wholesale expense of natural nitrogen. The scientist did not rest until he discovered, through the agency of bacteriology, that the valuable nitrogen could be captured from the atmosphere, whence it originally came. This fact was probably the most notable contribution which science has ever made to the progress of agriculture and, so far as we can see, the most notable it will ever be able to make. The dependence of man upon atmospheric nitrogen brought into form for plant use is beyond the power of comprehension.

Following "The Origin of Species," published by Darwin in 1859, and almost a generation of discussion, particularly among the theologians, the facts of evolution became well established and recently they have resulted in laying the foundation for rational methods of animal and plant breeding by which the systematic improvement of plants and animals and their adaptation to the needs of man are assured at a far less expenditure of time than heretofore and without the production of so large a proportion of worthless individuals.

An early field for scientific investigation was that of diseases, first of animals and afterward of plants. Indeed it was while work-

ing in this territory that some of the most important discoveries have been made, particularly concerning parasitic infection. The result of all this investigation has been the saving of enormous numbers of animals and of large acreage of plants by precautionary methods, such as quarantine, disinfection, etc., though the direct treatment of individual animals is generally inadvisable for economic reasons.

It is almost needless to remark that with these developments in the domain of agriculture much that was formerly tradition and superstition has begun to pass away. How recent it has all been, however, is shown by the fact that men still live who plant their seeds and kill their meat with reference to the phases of the moon, who treat "hollow-horn" and "wolf in the tail" by incantation, who put a red-hot horseshoe into the churn to drive the witches away, and who castrate only when the sign is right. While instances of this kind can still be found, it is yet true that the great masses of farmers to-day, even in the remoter agricultural districts, have caught the scientific spirit; and most of the material that now goes to constitute the revised agriculture of the twentieth century rests upon well established facts. So true is this that no man in these days can get a hearing anywhere upon any matter which does not rest, or at least seem to rest, upon experimental knowledge.

We have not yet reached the end of this development. We may be said to be just now in the very beginning of sanitary science regarding the operations of the farm. A man must do more now than to produce his milk or butter; he must produce it in a way which will assure the consumer that he is not taking communicable diseases in the milk, which is a kind of universal culture medium for everything which comes its way. It is this fact which has so notably raised the cost of city milk and is so appreciably reducing the mortality of infants.

Economics is perhaps the last of the sciences to reform the practices of agriculture. In the Far West it has taken the form of co-operative marketing, rendered necessary by the long expanse of mountain and desert over which fruit must be transported to reach the Eastern markets. In this way the last vestige of extreme individualism on the farm is being obliterated. What the passing of this individualism may mean so far as independence and the development of personal initiative are concerned, only time will tell; but one thing is clear—that as the facts in agriculture are developed by

scientific research, the truth stands out that the business of food production, to some extent at least, must be organized and conducted around larger units than that of a single farmer and his family.

The "organization of the farm" is a scientific conception of the most recent development. So long as wild lands could be had for mere occupancy, a farmer could get nothing out of his business but the bare return for labor; his land could have no value and there could be no investment except a slight one in implements and animals. Now, however, when the public domain is practically exhausted, competition for land will raise its price, food values must go up, for the farmer must realize income on capital as well as on labor, and his business is gradually assuming the form of other capitalized industries. This puts a new economic phase on agriculture and the whole question of how to organize and conduct a farm is a new one in economic science, as it is in agricultural practice. We still await its solution. Indeed, its serious study has only just begun.

The universal extension of agricultural education may be said to be the direct result of the development of scientific agriculture. There is little in mere handicraft that can be taught; it must mostly be acquired by experience. It is only when a subject has reached the scientific stage that it becomes teachable through the elucidation of the principles involved. Because of the ease and speed with which certain of these principles can be learned, and because of their immediate and far-reaching effect, particularly upon the permanence of agriculture, the demand is universal that the subject should be taught in as many of the schools as possible. The economist readily sees that the oldtime wasteful methods cannot prevail; that if we are to have a permanent civilization we must have a permanent food supply; and this must depend not upon practices that gradually impoverish the land, but rather on those scientific procedures which leave it each generation a little better than before in order that it may meet the demands of an increasing population with a more highly developed civilization.

This then is the aim and purpose of scientific agriculture: to replace tradition with well established facts; to substitute for the irregular and uncertain purposes of the individual a systematic and well organized business of food production by the community at large; to further adapt our domesticated animals and plants to the

purposes of man ; and to stop forever that reckless depletion of the power of the soil to produce, which will not only fix a low limit to the population of our country, but so weaken the constitution of the people as to lay the foundation for disease. It aims, too, to establish in these early and prosperous days, through education, such standards of living as shall prevent the coming of those hard conditions which have descended upon such races as have surrendered themselves to the mere business of getting a living on worn-out soil.